

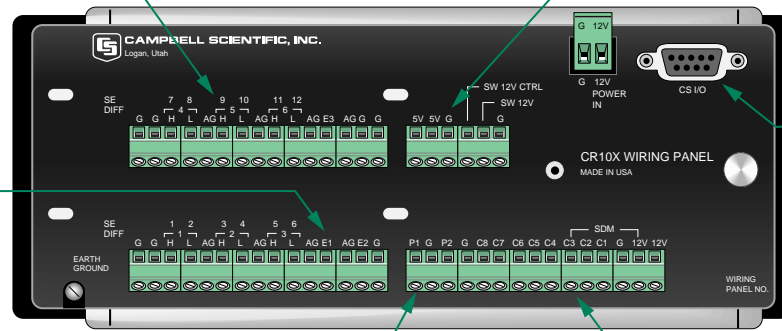
# System Description

The CR10X consists of a Measurement and Control Module and a detachable Wiring Panel. The Mean Time Between Failures (MTBF) for the CR10X is 130 years.

**6 Differential (12 single-ended) Analog Inputs** for measuring voltage levels on five software selectable voltage ranges.

**3 Switched Excitation Channels** for precision excitation of sensors or short-term actuation of external devices. Excitation is programmable over a  $\pm 2500$  mV range.

**2 Pulse Counting Channels** for switch closures, high frequency pulses, or low level AC measurement.



**Power and Ground Connections** for 12 V external batteries or peripherals or for 5 V peripherals. Switched 12 V terminal is controlled by any digital output.

**9-Pin CS I/O Port** for connection of data storage, retrieval, and telecommunications peripherals.

**8 Digital Inputs/Outputs** for output control, sensing status, and reading SDM peripherals or SDI-12 sensors.

## Measurement and Control Module

The module measures sensors, drives direct communications and telecommunications, reduces data, controls external devices, and stores data and programs in on-board, non-volatile storage. The electronics are RF shielded and glitch protected by the sealed, stainless steel cannister. A battery-backed clock assures accurate timekeeping. The multi-tasking operating system allows simultaneous measurement and communication.

The CR10X contains a comprehensive set of processing, math, and program control instructions to build a datalogger program. An optional operating system that supports Modbus protocol is available. This protocol enables the CR10X to interface with SCADA and MMI software packages. CSOS Downloading Software allows you to change or upgrade the CR10X's operating system without opening the datalogger and changing hardware. CSOS requires a direct communications link (e.g., SC32A, Short Haul modem).

The maximum rate the CR10X can execute its program is 64 times per second. (The maximum rate a single input can be measured is 750 samples per second.) Data and programs are stored either in non-volatile Flash memory or battery-backed SRAM. The standard memory stores 62,000 data points in two Final Storage areas. Optional versions store up to 1 million data points.

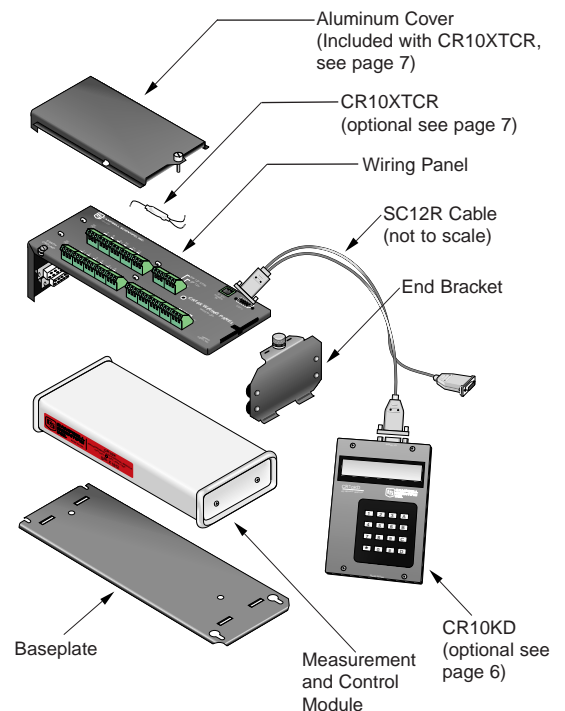
Standard operating range is  $-25^{\circ}$  to  $+50^{\circ}\text{C}$ . With the extended range option, the CR10X's electronics are tested and guaranteed over a  $-55^{\circ}$  to  $+85^{\circ}\text{C}$  range.

## SC12 and SC12R Cables

The SC12 cable is a ribbon cable that connects most communication devices to the CR10X's 9-pin port. The SC12R cable is a rugged, temperature resistant alternative that must be purchased separately.

## Wiring Panel

The Wiring Panel consists of a top and side panel, end bracket, and baseplate. The top panel includes screw terminals for sensor connections and a 9-pin CS I/O port; the end bracket attaches the Wiring Panel to the Control Module and to an enclosure-mounted or free-standing baseplate. The Control Module easily disconnects from the Wiring Panel allowing field replacement without rewiring the sensors. Gas tubes on the wiring panel provide rugged electrostatic discharge protection.



# CR10X Specifications

**Electrical specifications are valid over a -25° to +50°C range unless otherwise specified; non-condensing environment required. To maintain electrical specifications, yearly calibrations are recommended.**

## PROGRAM EXECUTION RATE

Program is synchronized with real-time up to 64 Hz. One measurement with data transfer is possible at this rate without interruption. Burst measurements up to 750 Hz are possible over short intervals.

## ANALOG INPUTS

NUMBER OF CHANNELS: 6 differential or 12 single-ended, individually configured. Channel expansion provided by AM416 Relay Multiplexers and AM25T Thermocouple Multiplexers.

ACCURACY:  $\pm 0.1\%$  of FSR (-25° to 50°C);  
 $\pm 0.05\%$  of FSR (0° to 40°C);  
e.g.,  $\pm 0.1\%$  FSR =  $\pm 5.0$  mV for  $\pm 2500$  mV range

RANGE AND RESOLUTION:

Full Scale Input Range (mV)	Resolution ( $\mu$ V)	
	Differential	Single-Ended
$\pm 2500$	333	666
$\pm 250$	33.3	66.6
$\pm 25$	3.33	6.66
$\pm 7.5$	1.00	2.00
$\pm 2.5$	0.33	0.66

INPUT SAMPLE RATES: Includes the measurement time and conversion to engineering units. The fast and slow measurements integrate the signal for 0.25 and 2.72 ms, respectively. Differential measurements incorporate two integrations with reversed input polarities to reduce thermal offset and common mode errors.

Fast single-ended voltage:	2.6 ms
Fast differential voltage:	4.2 ms
Slow single-ended voltage:	5.1 ms
Slow differential voltage:	9.2 ms
Differential with 60 Hz rejection:	25.9 ms
Fast differential thermocouple:	8.6 ms

INPUT NOISE VOLTAGE (for  $\pm 2.5$  mV range):

Fast differential:	0.82 $\mu$ V rms
Slow differential:	0.25 $\mu$ V rms
Differential with 60 Hz rejection:	0.18 $\mu$ V RMS

COMMON MODE RANGE:  $\pm 2.5$  V

DC COMMON MODE REJECTION: >140 dB

NORMAL MODE REJECTION: 70 dB (60 Hz with slow differential measurement)

INPUT CURRENT:  $\pm 9$  nA maximum

INPUT RESISTANCE: 20 Gohms typical

## ANALOG OUTPUTS

DESCRIPTION: 3 switched, active only during measurement, one at a time.

RANGE:  $\pm 2.5$  V

RESOLUTION: 0.67 mV

ACCURACY:  $\pm 5$  mV;  $\pm 2.5$  mV (0° to 40°C);

CURRENT SOURCING: 25 mA

CURRENT SINKING: 25 mA

FREQUENCY SWEEP FUNCTION: The switched outputs provide a programmable swept frequency, 0 to 2.5 V square wave for exciting vibrating wire transducers.

## RESISTANCE MEASUREMENTS

MEASUREMENT TYPES: The CR10X provides ratiometric bridge measurements of 4- and 6-wire full bridge, and 2-, 3-, and 4-wire half bridges. Precise dual polarity excitation using any of the switched outputs eliminates dc errors. Conductivity measurements use a dual polarity 0.75 ms excitation to minimize polarization errors.

ACCURACY:  $\pm 0.02\%$  of FSR plus bridge resistor error.

## PERIOD AVERAGING MEASUREMENTS

DEFINITION: The average period for a single cycle is determined by measuring the duration of a specified number of cycles. Any of the 12 single-ended analog input channels can be used. Signal attenuation and AC coupling is typically required.

INPUT FREQUENCY RANGE: Signal centered around ground

Min. volts (peak-peak) @ Max. freq.	Max. Input Frequency
2 mV	8 kHz
5 mV	20 kHz
12 mV	40 kHz
2000 mV	200 kHz

RESOLUTION: 35 ns divided by the number of cycles measured

ACCURACY:  $\pm 0.03\%$  of reading

TIME REQUIRED FOR MEASUREMENT: Signal period times the number of cycles measured plus 1.5 cycles + 2 ms

## PULSE COUNTERS

NUMBER OF PULSE COUNTER CHANNELS: 2 eight-bit or 1 sixteen-bit; software selectable as switch closure, high frequency pulse, and low level AC.

MAXIMUM COUNT RATE: 16 kHz, eight-bit counter; 400 kHz, sixteen-bit counter. Channels are scanned at 8 or 64 Hz (software selectable).

SWITCH CLOSURE MODE

Minimum Switch Closed Time:	5 ms
Minimum Switch Open Time:	6 ms
Maximum Bounce Time:	1 ms open without being counted

HIGH FREQUENCY PULSE MODE

Minimum Pulse Width:	1.2 $\mu$ s
Maximum Input Frequency:	400 kHz
Voltage Thresholds:	Count upon transition from below 1.5 V to above 3.5 V at low frequencies. Larger input transitions are required at high frequencies because of input filter with 1.2 $\mu$ s time constant. Signals up to 400 kHz will be counted if centered around +2.5 V with deviations $\geq \pm 2.5$ V for $\geq 1.2$ $\mu$ s.
Maximum Input Voltage:	$\pm 20$ V

LOW LEVEL AC MODE

(Typical of magnetic pulse flow transducers or other low voltage, sine wave outputs.)

Input Hysteresis: 14 mV

Maximum AC Input Voltage:  $\pm 20$  V

Minimum AC Input Voltage: (Sine wave mV RMS)	Range (Hz)
20	1.0 to 1000
200	0.5 to 10,000
1000	0.3 to 16,000

## DIGITAL I/O PORTS

8 ports, software selectable as binary inputs or control outputs. 3 ports can be configured to count switch closures up to 40 Hz.

OUTPUT VOLTAGES (no load): high 5.0 V  $\pm 0.1$  V; low < 0.1 V

OUTPUT RESISTANCE: 500 ohms

INPUT STATE: high 3.0 to 5.5 V; low -0.5 to 0.8 V

INPUT RESISTANCE: 100 kohms

## SDI-12 INTERFACE STANDARD

DESCRIPTION: Digital I/O Ports C1-C8 support SDI-12 asynchronous communication; up to ten SDI-12 sensors can be connected to each port. Meets SDI-12 Standard version 1.2 for datalogger and sensor modes.

## CR10XTCR THERMOCOUPLE REFERENCE

POLYNOMIAL LINEARIZATION ERROR: Typically  $< \pm 0.5^\circ\text{C}$  (-35° to +50°C),  $< \pm 0.1^\circ\text{C}$  (-24° to +45°C).

INTERCHANGEABILITY ERROR: Typically  $< \pm 0.2^\circ\text{C}$  (0° to +60°C) increasing to  $\pm 0.4^\circ\text{C}$  (at -35°C).

## EMI and ESD PROTECTION

EMISSIONS: Meets or exceeds following standards:  
Radiated: per EN 55022:1987 Class B  
Conducted: per EN 55022:1987 Class B

IMMUNITY: Meets or exceeds following standards:  
ESD: per IEC 801-2; 1984 8 kV air discharge  
RF: per IEC 801-3; 1984 3 V/m, 27-500 MHz  
EFT: per IEC 801-4; 1988 1 kV mains, 500 V other

## CE COMPLIANCE (as of 01/98)

APPLICATION OF COUNCIL DIRECTIVE(S):  
89/336/EEC as amended by 89/336/EEC and 93/68/EEC

STANDARD(S) TO WHICH CONFORMITY IS

DECLARED:  
ENC55022-1: 1995 and ENC50082-1: 1992

## CPU AND INTERFACE

PROCESSOR: Hitachi 6303

PROGRAM STORAGE: Up to 16 kbytes for active program; additional 16 kbytes for alternate programs. Operating system stored in 128 kbytes Flash memory.

DATA STORAGE: 128 kbytes SRAM standard (approximately 60,000 data values). Additional 2 Mbytes Flash available as an option.

OPTIONAL KEYBOARD DISPLAY: 8-digit LCD (0.5" digits)

PERIPHERAL INTERFACE: 9 pin D-type connector for keyboard display, storage module, modem, printer, card storage module, and RS-232 adapter.

BAUD RATES: Selectable at 300, 1200, 9600 and 76,800 for synchronous devices. ASCII communication protocol is one start bit, one stop bit, eight data bits (no parity).

CLOCK ACCURACY:  $\pm 1$  minute per month

## SYSTEM POWER REQUIREMENTS

VOLTAGE: 9.6 to 16 Vdc

TYPICAL CURRENT DRAIN: 1 mA quiescent, 13 mA during processing, and 46 mA during analog measurement.

BATTERIES: Any 12 V battery can be connected as a primary power source. Several power supply options are available from Campbell Scientific. The Model CR2430 lithium battery for clock and SRAM backup has a capacity of 270 mAh.

## PHYSICAL SPECIFICATIONS

SIZE: 7.8" x 3.5" x 1.5" - Measurement & Control Module; 9" x 3.5" x 2.9" - with CR10WP Wiring Panel. Additional clearance required for serial cable and sensor leads.

WEIGHT: 2 lbs

## WARRANTY

Three years against defects in materials and workmanship.

We recommend that you confirm system configuration and critical specifications with Campbell Scientific before purchase.



**CAMPBELL SCIENTIFIC, INC.**

815 W. 1800 N. • Logan, Utah 84321-1784 • (435) 753-2342 • FAX (435) 750-9540  
Offices also located in: Australia • Brazil • Canada • England • France • South Africa

Copyright © 1986, 2000  
Campbell Scientific, Inc.  
Printed May 2000